

longer maintain lift. The airplane controls its direction of flight through the use of ailerons, elevators, and rudders.

In airplane mode, the tiltrotor function is exactly the same as a typical airplane. In forward flight, the tiltrotor is supported by the lift of its wing. Its turboshaft engines driving the proprotors sustain its speed. Its controls are ailerons, elevators and rudders, and function exactly like a conventional airplane. However, for low speed or hovering flight, a tiltrotor can rotate its nacelles (i.e., its thrust direction) from the horizontal to the vertical position — something an airplane cannot do.

Finally, a tiltrotor's proprotors are much larger than an airplane propeller; consequently the proprotors can generate the same amount of thrust as an airplane at a much slower RPM. The lower tip speed of the tiltrotor makes it very quiet in cruise flight, even at high speeds.

Flying a Tiltrotor

The tiltrotor is easy to fly. The pilot controls both flight modes with a single set of controls. The conventional airplane stick, rudder pedals, and thrust lever automatically function like a cyclic stick, yaw pedals, and collective control in a helicopter. The flight control system is designed to change the flight control functions automatically and transparently as aircraft speed increases or decreases during conversion.

In a tiltrotor, the pilot also controls nacelle angle. Using nacelle controls provides an additional method to translate forward and aft and turn, completely independent of fuselage attitude or cyclic pitch.

See *Aircraft Flight Control* for details of how the various pilot controls control the aircraft in each flight mode.

Conversion

The process of rotating the nacelles to transition between helicopter and airplane modes is called conversion.

The conversion procedure is simple, straight forward, and easy to accomplish. The amount and rate of nacelle tilt is completely controlled by the pilot or can be performed automatically by the flight control system. (The V-22 can perform a complete conversion from hover to airplane forward flight mode within 12 seconds.)

Conversion is not a dynamic maneuver - a maneuver that must be accomplished within a set amount of time. A tiltrotor can fly at any degree of nacelle tilt.

During vertical takeoff, conventional helicopter controls are utilized. As the tiltrotor gains forward speed to between 40 to 80 knots, the wing begins to produce lift and the ailerons, elevators, and rudders become effective. At this point, rotary-wing controls are gradually phased out by the flight control system. At approximately 100 to 120 knots the wing is fully-effective and cyclic pitch control of the proprotors is phased out.